Bacteria TMDL in the Limestone Branch Watershed

First Public Meeting

December 16, 2003

Presentation Overview

1. Overview of Virginia's TMDL Program

2. Applicable Water Quality Standard

3. Limestone Branch Impairment

4. TMDL Development Approach

5. Bacteria Source Assessment

What is a TMDL ?

- TMDL stands for **Total Maximum Daily Load**

- A TMDL is a **pollution budget**

- A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet **water quality standards**

- A TMDL includes an **allocation** of that maximum amount to the pollutant's sources

TMDL Equation

A TMDL is summarized as:

TMDL = Sum of WLA + Sum of LA + MOS

Where:

- TMDL = Total Maximum Daily Load
- WLA   = Waste Load Allocation (point sources)
- LA   = Load Allocation (nonpoint sources)
- MOS   = Margin of Safety

How is a TMDL developed?

- Identify all sources of a given pollutant within the watershed

- Calculate the amount of pollutant entering the stream from each source

- Calculate the pollutant reductions needed, by source, to attain water quality standards

- Allocate the allowable loading to each source and include a margin of safety

When are TMDLs needed?

- State and federal law require TMDLs to be developed for **impaired** waters

- Impaired waters do not meet applicable **water quality standards** (WQS)

- Waters that do not meet WQS do not support their **designated use(s)**

- For bacteria impairments, the designated use that is affected is the **recreational use**

Regulatory Basis of TMDLs

- TMDLs required by Federal and State law
  - 1972 Clean Water Act (CWA), Section 303(d)
  - 1997 Water Quality Monitoring, Information and Restoration Act (WQMIRA)
- 1998 lawsuit filed by the American Canoe Association and the American Littoral Society against EPA for failure to comply with CWA §303(d) in Virginia
- 1999 Consent Decree requiring EPA and Virginia to complete 636 TMDLs by 2010

Regulatory Requirements

- Both state and federal law require:
  - Establishment of water quality standards
  - Monitoring of water quality in surface waters
  - Assessment of water quality in surface waters
  - Listing of waters that do not meet water quality standards (impaired waters)
  - Development of TMDLs for impaired waters
- State law requires, and federal law recommends:
  - Development of a TMDL Implementation Plan

Roles of DEQ and DCR in TMDL and IP Development

- DEQ is the lead for TMDL development, including submittal to EPA

- DCR is the lead for TMDL Implementation Plan (IP) development

- DEQ is responsible for ensuring public participation in the TMDL program

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Water Quality Standards

- Water Quality Standards (WQS):
  - set by states and approved by EPA
  - set **numeric** and **narrative** limits on pollutants
  - consist of **designated use(s)** and water quality **criteria**
- Purpose of WQS:
  - **protection** of 5 designated uses (aquatic life, fish consumption, shellfish, recreation, drinking water)
 - **restoration** of state waters to meet criteria

Applicable Designated Use

- All surface waters in Virginia are currently designated for **primary contact recreation** (e.g. swimming)

- In March 2003, a **secondary contact recreation** use designation (e.g. wading, fishing) was added to the WQS
  - Five times the primary contact criteria
  - Individual waters will only be considered for reclassification after TMDL implementation has been tried using reasonable BMPs
  - Effective date pending EPA approval

Pollutant of Concern

- *Fecal bacteria* are found in the digestive tract of humans and warm blooded animals
- Fecal bacteria are an indicator of the potential **presence of pathogens** in waterbodies
- The presence of fecal bacteria in water samples is a strong indicator of recent **sewage or animal waste contamination**

Sampling for Bacteria

- Stream samples are collected in sterile 125 mL sample bottles

- Samples are filtered to deposit bacteria on filters

- Filters are incubated, allowing individual bacteria to grow into visible colonies

- Colonies are counted to give a concentration of colony forming units (cfu) per 100 mL
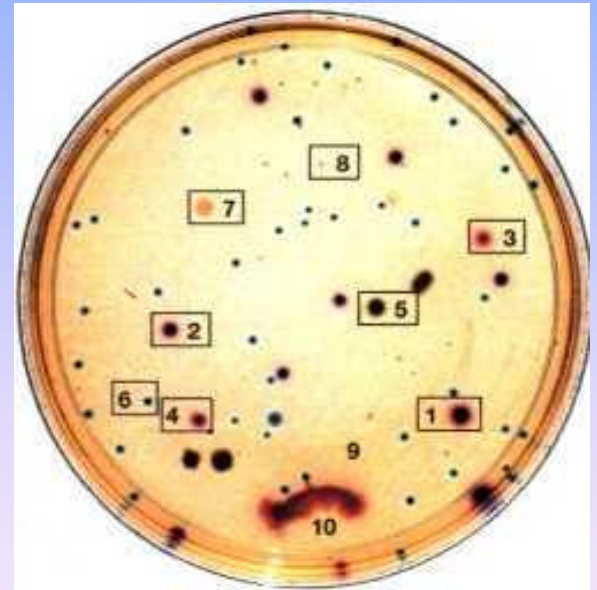
Old Criteria

- Indicator species: **fecal coliform**
  - used in listing Limestone Branch

- **Instantaneous max**:
  1,000 cfu/100 mL

- Applicable for data sets with 1 or fewer samples in 30 days

- **Geometric mean:**
  200 cfu/100 mL

- Applicable for data sets with 2 or more samples in 30 days

New Criteria

- Indicator species for freshwater: *E. coli*
  - change in indicator species from fecal coliform to *E. coli* (fresh water)
  - *E. coli* bacteria are a **subset of fecal coliform** bacteria and correlate better with swimming-associated illness

- **Instantaneous max**:
  235 cfu/100 mL

- Applicable for all data sets; no samples may exceed the maximum

- **Geometric mean:**
  126 cfu/100 mL

- Applicable for data sets with 2 or more samples in a calendar month

Summary of Changes in Primary Contact Criteria

Indicator	Status	Instantaneous Maximum (cfu/100mL)	Geometric Mean (cfu/100 mL)
Fecal Coliform	Old	1,000	200
E. coli	New	235	126
Fecal Coliform	Interim	400	200

- Changes went into effect on January 15, 2003
- Both New *E. coli* and Interim Fecal Coliform criteria apply
- Fecal coliform criteria will be phased out entirely once 12 *E. coli* samples have been collected or after June 30, 2008

Comparison of the Old Fecal Coliform and New *E. coli* Criteria

Old FC (cfu/100mL)	Interim FC (cfu/100mL)	FC translated to EC* (cfu/100mL)	New EC (cfu/100mL)
200	200	129	126
	400	243	235
1,000		565	

* Based on regression model between 493 dual data points
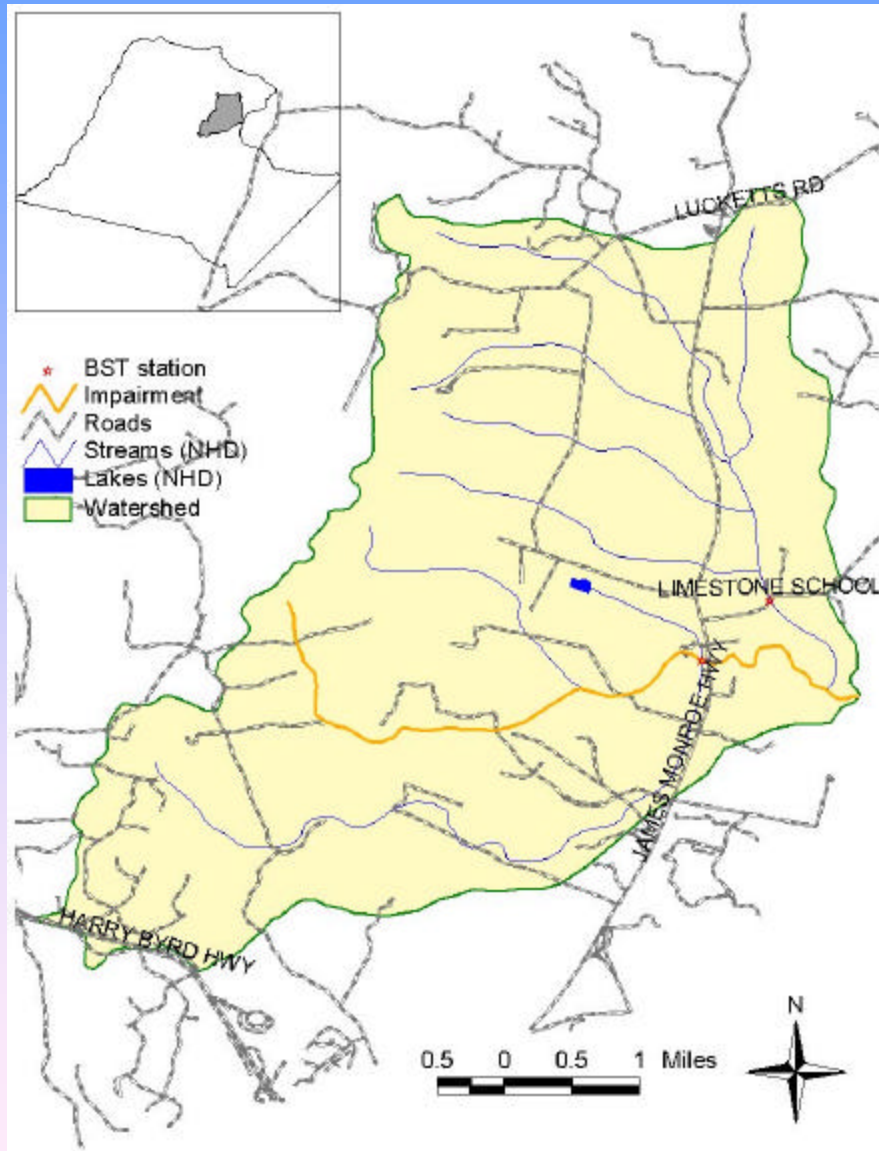Note: FC = Fecal Coliform, EC = *Escherichia Coli*

Presentation Overview

Impairment in the Limestone Branch Watershed

WATER BODY	CAUSE	STREAM NAME	LENGTH (Miles)	YEARS LISTED
VAN-A03R	Bacteria	Limestone Branch (from headwaters to confluence with Potomac River)	4.75	2002

Map of the Limestone Br. Watershed

- DEQ monitoring station: 1ALIM001.16

- Special Study station: 1AXAQ000.85

- USGS flow gage: 01643590

- 2002 305(b) results: 9 of 22 samples (41%) exceeding 1000 cfu/100mL

- 2000 305(b) results: 7 of 16 (44%)

Fecal Coliform in Limestone Branch
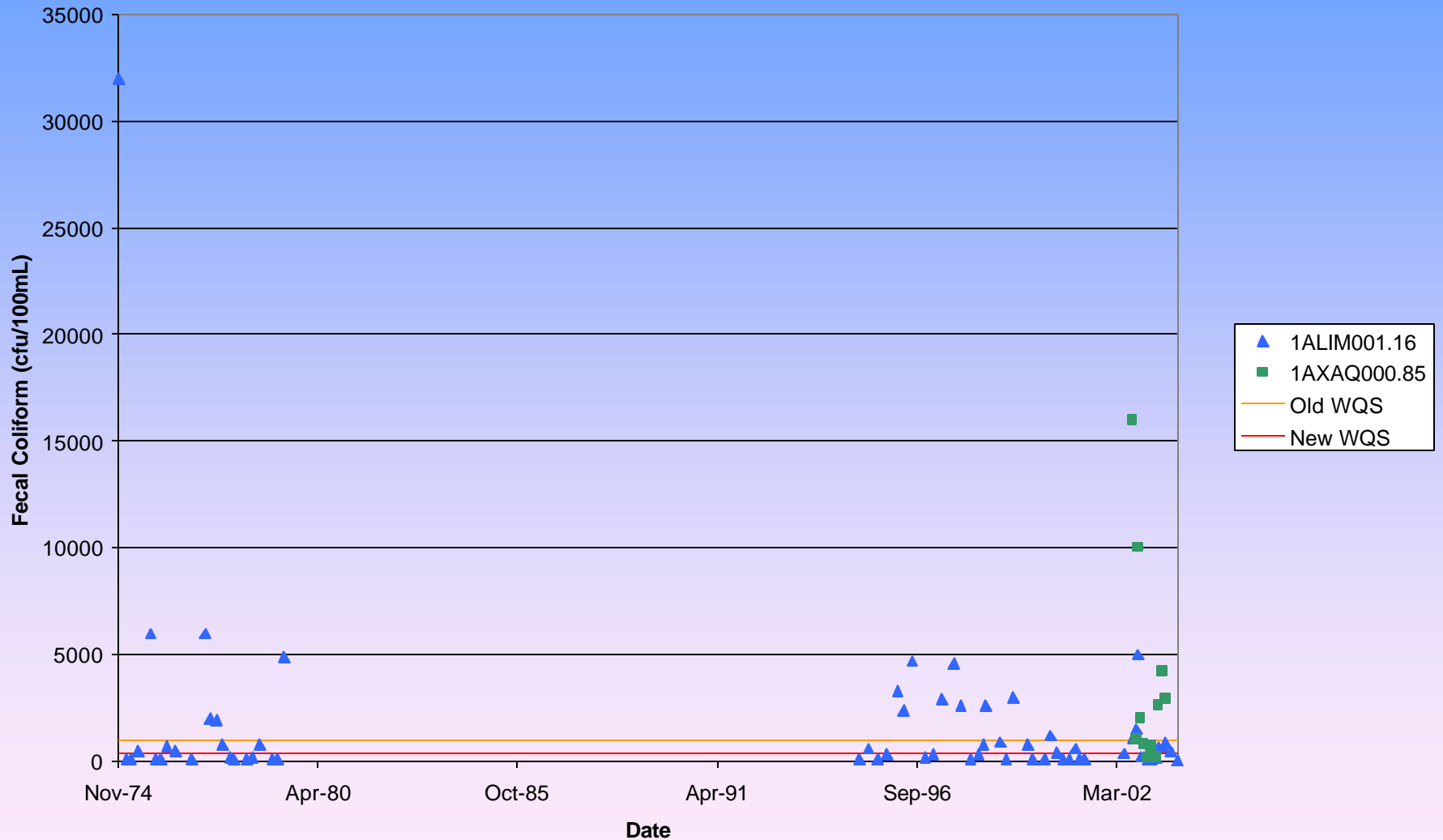
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What is Load Duration Analysis?

- Less complex spreadsheet model for TMDL development

- Approach proposed for bacteria TMDLs in small watersheds

- Model requires
  - stream flow data
  - ambient water quality data, and
  - bacteria source tracking data (for pollutant source identification and loading allocations)

Development of Flow Duration Curve for Limestone Branch

- Limestone Branch has a USGS flow gaging station that was established in 2001

- In order to include the time period that led to the listing (1/1/1996 to 12/31/2000 for the most recent assessment), the flow record must be extended

Reference Stream Selection

- Flows were correlated with Catoctin, Goose and Passage Creeks

- The period from 1988 to present was used

- Limestone Branch flows correlated best with Catoctin Creek (0.8090)

- Flow regression equations were then used to generate continuous flow records (1988-03)

Limestone Branch Flow Duration Curve
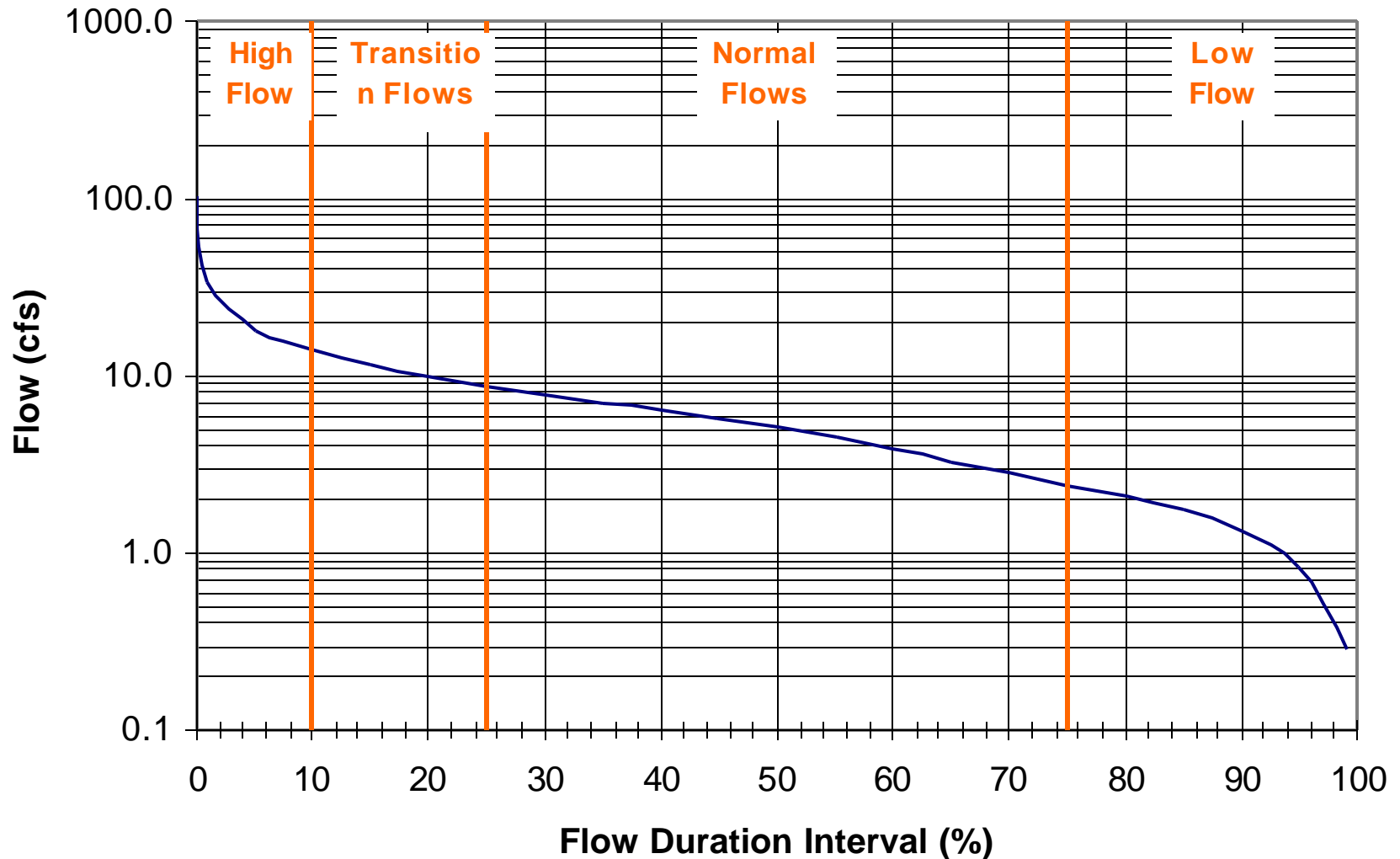
Load Duration Curve

- Represents the maximum amount of a pollutant allowed at each flow level

- Obtained by multiplying the flow duration curve by the water quality criterion

- At higher flows, a stream will have more assimilative capacity

- At lower flows, it will have less assimilative capacity

Limestone Branch Load Duration Curve
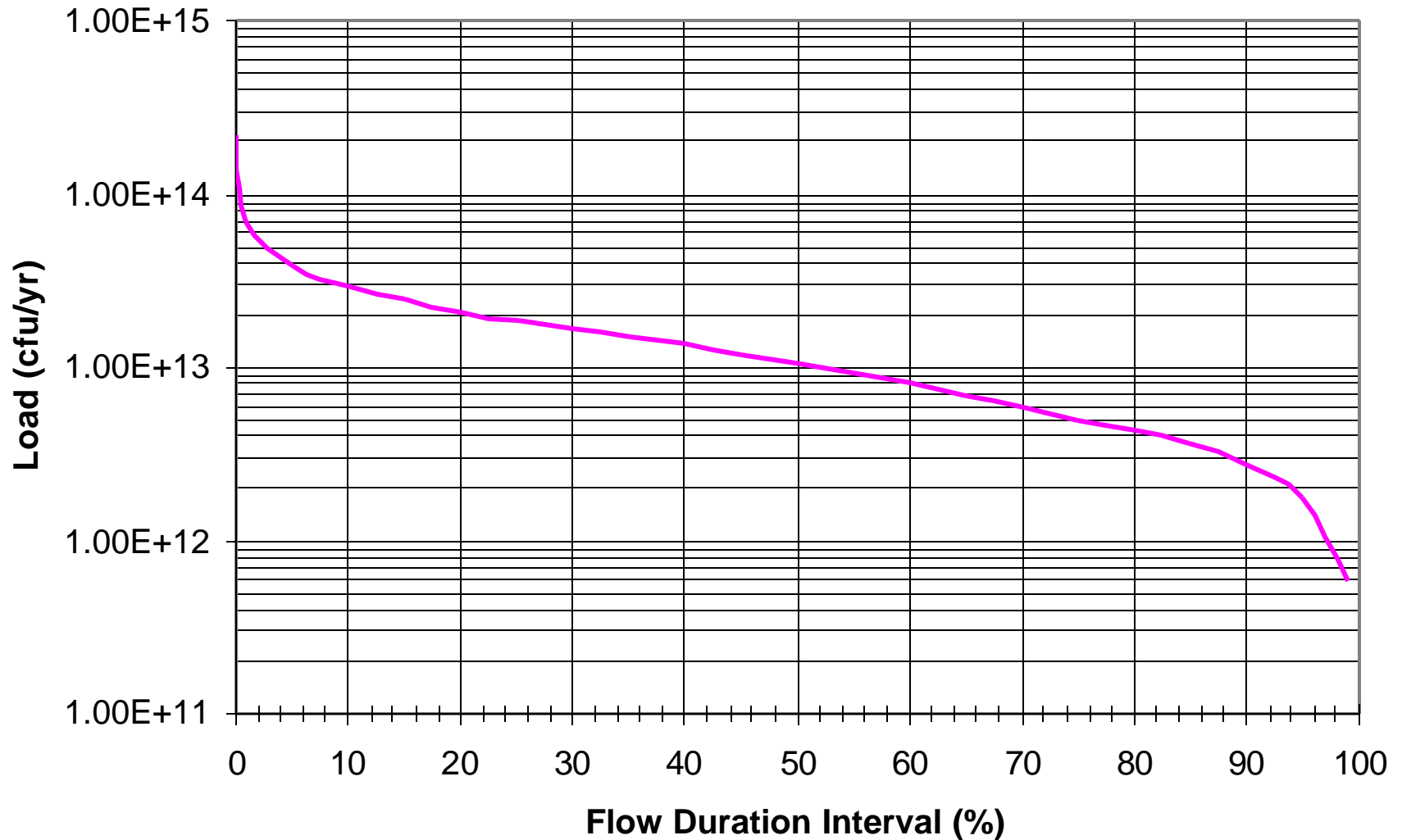
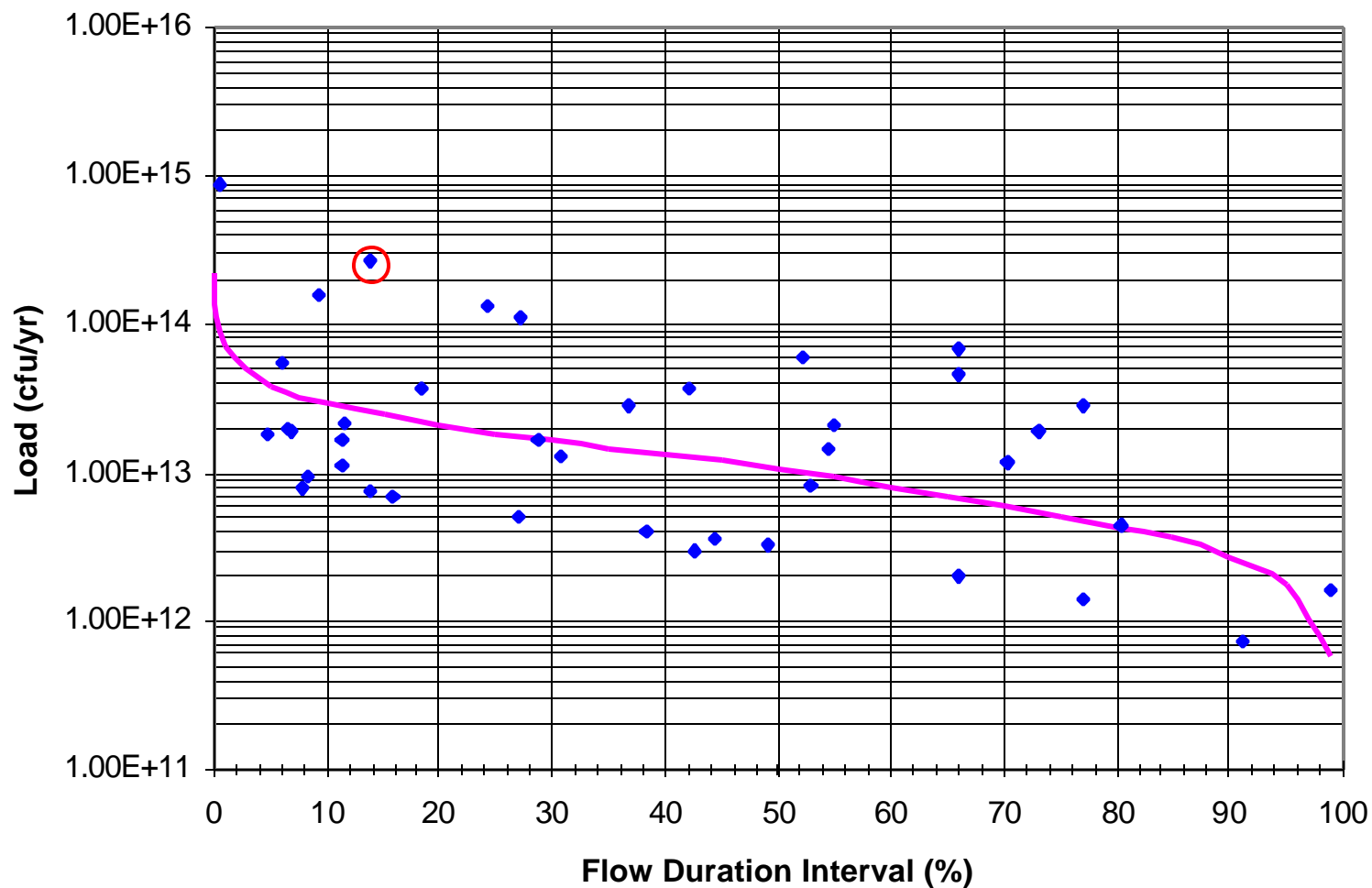# TMDL Required Reduction

- The TMDL must ensure water quality is protected during times when stream is most vulnerable

- The stream is assumed to be most vulnerable when the highest exceedance occurs

- This critical condition occurred on 10/17/2002, with an observed concentration of 2479 cfu/100mL at an estimated flow of 12.17 cfs

Limestone Branch Load Duration Curve

Limestone Branch TMDL
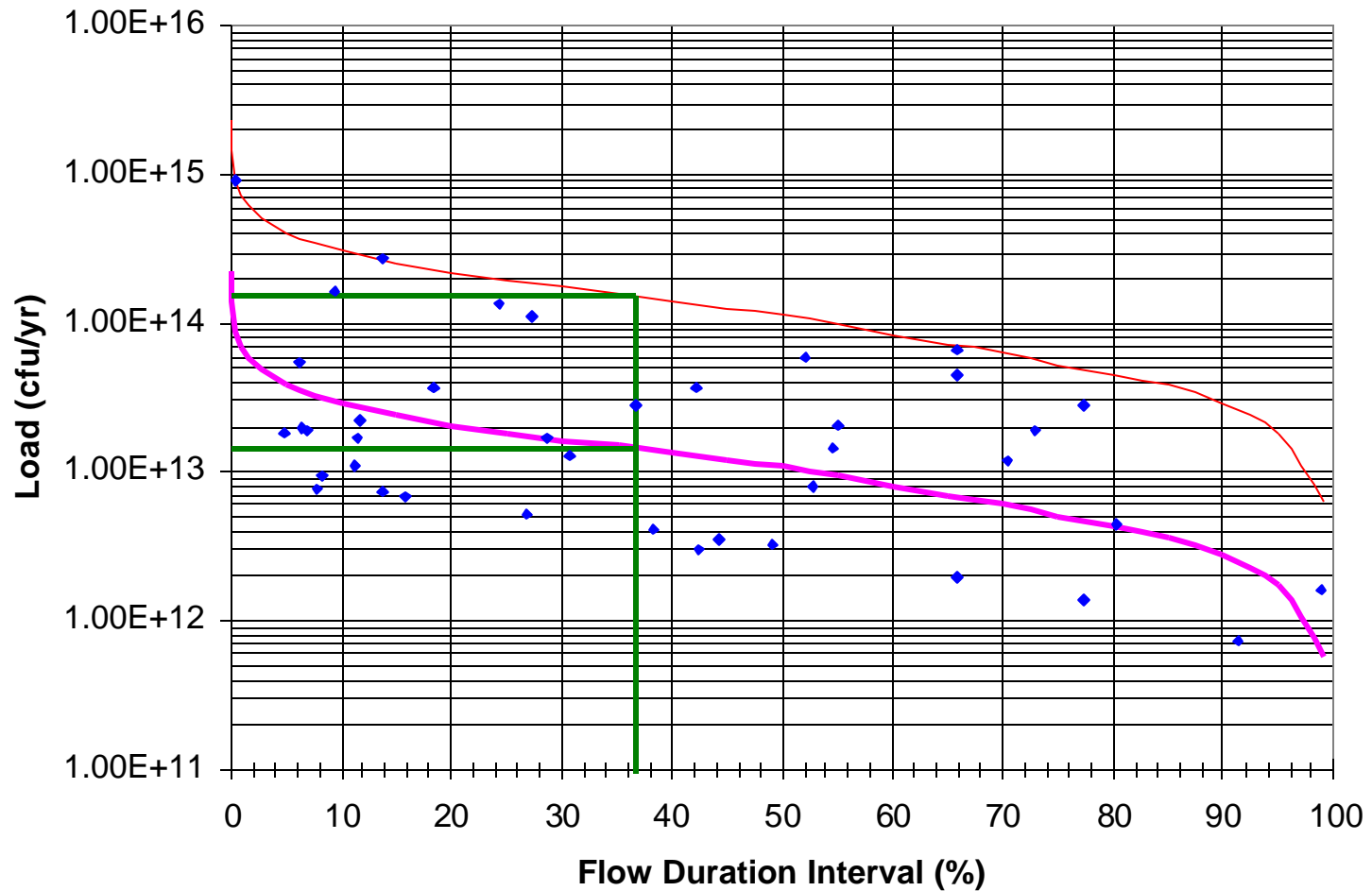
TMDL Reduction Required

- The TMDL equation is then calculated using the maximum observed exceedance and average flow conditions (6.84 cfs)

- At average flow:
  - the existing load is 1.51×10^{14} cfu/yr
  - the allowable load is 1.44×10^{13} cfu/yr
  - the required reduction is 1.37×10^{14} cfu/yr

- This corresponds to a 91% reduction

Development of TMDL Allocations

- Assume an implicit margin of safety due to conservative assumptions

- Subtract point source loads from the TMDL load to obtain the non-point source load

- Use results of source assessment and BST study to allocate the non-point source loads among sources (human, livestock, wildlife)

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Land Use in the Limestone Branch Watershed
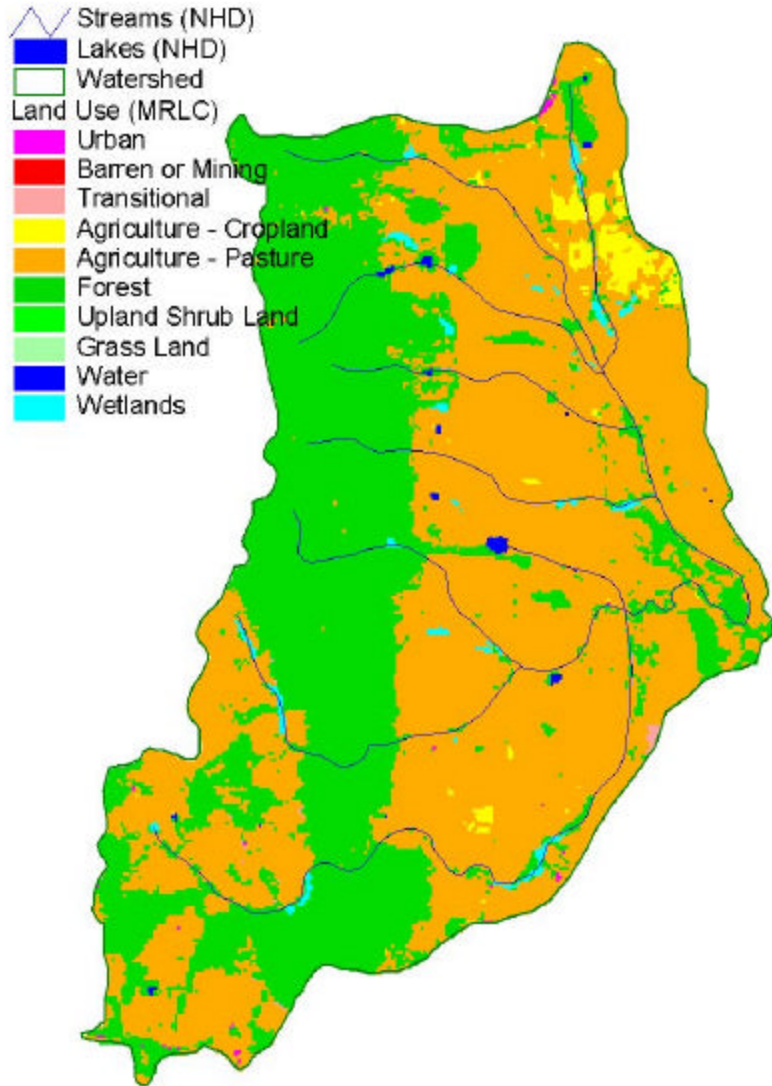
MRLC Land Use	Limestone Branch	
	Acres	Percent
Cropland	158	1.6%
Pasture	5,725	57.5%
Barren or Mining	0	0.0%
Forest	3,934	39.5%
Transitional	11	0.1%
Urban	13	0.1%
Water	24	0.2%
Wetlands	86	0.9%
Total	9,950	100.0%

Potential Sources of Bacteria in Limestone Branch

- Humans/Pets
  - Straight Pipes
  - Septic Systems
  - Biosolids
  - Permitted Point Sources
  - Pets

- Livestock
  - Direct Deposit to Land and Streams
  - Land Application

- Wildlife
  - Direct Deposit to Land and Streams

Potential Human and Pet Sources

Clogged Drainfield

←surfacing effluent

PLEASE CONTROL YOUR SPEED
SHARE THE TRAIL

DOG WASTE
TRANSMITS DISEASE
CONTAMINATES DRINKING WATER
LEASH – CURB AND CLEAN UP
AFTER YOUR
DOG
IT'S THE LAW!
$25.00 TO $200.00 FINE

TRAIL ETIQUETTE
LAKE ACCOTINK PARK
Share the trail, respect others.
Maintain proper control of bicycles at all times.
Faster users should pass on the *left*.
Announce your passing clearly. Passing on your left!
Stay on existing trails.
Stay off single-track trails when raining or
muddy. All traffic on wet trails causes damage.

Estimated Human and Pet Sources

Source	Limestone Branch	Reference
People	1,606	2000 Census
Dogs	903	2000 Census, APPMA
VPDES Permits	6	VADEQ
SFH Permits	0	VADEQ
Septic Systems	TBD	Loudoun Co. Health Dept.
Straight Pipes	TBD	Loudoun Co. Health Dept.
Biosolids	TBD	Loudoun Co. Health Dept.

Permit No.	Facility Name	Design Flow
VA0021750	Lucketts Elementary School	0.0063 MGD
VA0067938	Piedmont Behavioral Health Center WWTP	0.01 MGD
VA0074942	Hiway Mobile Home Community LLC	0.012 MGD
VA0088196	Raspberry Falls Sewage Treatment Plant	0.06 MGD
VA0090662	Selma Plantation WWTP	0.105 MGD
VA0091171	Oakwoods Sewage Treatment Plant	0.09 MGD

Potential Livestock Sources

Estimated Livestock Sources

Source	Limestone Branch	Reference
Cattle and calves	800	1997 Ag Census/Loudoun SWCD
Beef Cows	400	1997 Ag Census/Loudoun SWCD
Hogs and Pigs	0	1997 Ag Census/Loudoun SWCD
Sheep and Lambs	90	1997 Ag Census/Loudoun SWCD
Layers	75	1997 Ag Census/Loudoun SWCD
Broilers	0	1997 Ag Census/Loudoun SWCD
Horses	100	Loudoun SWCD

- Livestock numbers estimates based on discussion with the Loudoun Soil and Water Conservation District (12/11/2003)

Potential Wildlife Sources

Estimated Wildlife Sources

Animal	Habitat	Density	Limestone Branch
Deer	Forest, Agriculture, Urban Pervious	0.084 per acre	826
Raccoons	Within 600 ft of streams	0.07 per acre	233
Muskrats	Within 66 ft of streams	2.75 per acre	1,020
Beavers	Streams	4.8 per mile	124
Turkeys	Forest	0.01 per acre	39
Ducks	Within 66 ft of streams	0.008 per acre	3
Geese	Within 66 ft of streams	0.02 per acre	7

- Wildlife numbers estimated based on habitat types and animal densities from the Catoctin and Goose Creek bacteria TMDLs

Bacteria TMDL for the Limestone Branch Watershed

- First public meeting:
  - Tuesday, December 16
    - Lucketts Community Center, 42361 Lucketts Rd, Leesburg, VA

- Second and final public meeting will be held in February 2004
  - Results of BST study
  - Draft report for comment

Bacteria TMDL for the Limestone Branch Watershed

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Interim Criteria

- Indicator species: **fecal coliform**
  - will be phased out when 12 *E. coli* observations available or after June 30, 2008, whichever comes first
  - will not be used to assess compliance

- **Instantaneous max**:
  400 cfu/100 mL

- Applicable for all data sets; no more than 10% of samples in a calendar month may exceed the maximum

- **Geometric mean:**
  200 cfu/100 mL

- Applicable for data sets with 2 or more samples in a calendar month